

User's Manual Section – Philosophy behind the development of VIROMET

Singapore Asahi Chemical and Solder Industries Private Limited thank you for selecting our Lead Free materials for your applications. In the interest of getting the best performance out of your process/product, may we ask that you take the time to read through this manual first, please? If you wish to know still more about us and all our materials, you might consider investing in a copy of the VIROMET Book: if so, please write enquiring about ordering it.

Much of the information contained in this little manual has been accessible only in our technical bulletin goes along with the sales of our alloy. Some of the concepts and ideas have never appeared in print at all. Most has been gleaned from more than half of century in the high end electronics assembling and fabricating industry, wherein we have proven out our materials and design philosophies. We hope therefore that you will find yourself both informed and entertained.

Before going into any technological details about VIROMET Lead Free alloy, it might be in order to state our on-going goal is to offer discerning industrial premium-quality, mechanically and electrically sound material at a price that allows us to earn a conscience profit, and to produce this material with fierce pride. It is this pride and dedication to quality of our material that makes it possible for you to manufacture your products with confidence knowing the unsurpassed reliability performance in it --- quite possible one of your major reasons for choosing VIROMET in the first place.

We believe deeply that well-designed and executed Lead Free materials have continuously demonstrated their superiority over the conventional solder alloy which has been used in the industry for past decades. No question, the VIROMET is an invention that borders on the miraculous; and we believe it has its best uses in high end electronics products which concern life safety aspects. Ask the technician and engineer; the most stringent and cruelest manufacturing environment demands no less in terms of defects and high throughput in its finished products made with VIROMET.

True, usable and high performance Lead Free material has never been inexpensive to buy; and true also that a very good value-for money “high temperature” Lead Free material is also available to industry – a direct result of compromise of its reliability/yield performance and process/board/component compatibility.

To use such mediocre Lead Free material in your mass production, of course, is not without its price. Nothing will demonstrate this more than actually comparing to the manufacturing process/equipment which uses VIROMET, and seeing this for yourself. Quite frankly, the difference is not subtle.

All VIROMET material is designed to operate on the various wave soldering machines, SMT Reflow Ovens, and soldering irons around the world.

The main compositions in our VIROMET products have various percentage of Indium that uses the following product coding:

VIROMET LEAD FREE PRODUCT CODE

VIROMET 349	4% INDIUM
VIROEMT 347	7% INDIUM
VIROMET 312	12% INDIUM

These materials have melting temperature which is below 210 degree Celsius. Hence any wave soldering machine with operating temperature from 240 to 250 degree Celsius can accommodate the use of these materials.

Similarly, these materials can be used in conventional 4 zones reflow oven as well as oven with higher heat capacity of up to 10 zones. However, we stress that the peak reflowed temperature in these ovens for the alloy should not be set more than 230 degree Celsius. VIROMET solder paste contains ingredients with highly sophisticated and chemically well balanced formulations for it to perform optimally and to be used as a direct replacement of conventional Leaded based solder pastes with peak reflowed temperature usually set between 220 to 230 degree Celsius.

We do not recommend a reflow profile with extremely long soaking and higher preheating zone for the use with our VIROMET solder pastes, only for the reason that this is wasteful of both electrical energy (money, therefore) and throughput of your production yield. You will not find the excellence in the reliability aspects of your assemblies subject to such long and higher temperature preheat, though of course we agree that more expensive board material such as CAM3 and/or FR-4 board can withstand thermally under such long profile.

From applications point of view, using VIROMET to create joints in your assemblies is totally safe and is extremely reliable under the normal conditions of usage, provided it is not tempered with by using a higher operating temperature in the wave or reflow process.

Always use VIROMET in your process with sufficient ventilation same as those needed for the conventional solder process. We disapprove strongly inhale of exhaust of fume generated in the process with VIROMET since most fume contains unwanted chemical particles, albeit non-toxic in nature. A trained technician knows how to safely dispose off the discharge and production waste of VIROMET, the contents of which is included in our MSDS data sheets.

Though we dearly wish it otherwise, we cannot insist that assemblies with the use of VIROMET in the Wave Soldering process and/or SMT reflow be subsequently reworked or touched up with only our VIROMET wire. We do not, however, think it requires a great deal of understanding to conclude that our VIROMET materials are conceived to perform at their best in concert, so to speak. But for those who do, for reasons of their own, choose to “mix and mismatch” various Lead Free material compositions and designs, let us please spell out our parameters.

First, though this was not intended by design, VIROMET will go well almost all other Lead Free materials available in the market nowadays, except Tin Zinc based alloy. Commonly known to all Lead Free materials, VIROMET should not be mixed with Tin Lead based alloy (solder alloy such as 63/37). From the metallurgical aspect, it has proven Lead particles

segregation is detrimental in the reliability aspects when both are mixed together with Lead content of more than 4000ppm in the final joint.

For the purpose of using wires for rework on certain joints within the assembly, the best suited to all boards, with board either subjected to single “heat” pass process or multiple “heat” passes (says board that firstly undergone wave soldering and followed with reflow on chip components), would be our VIROMET wire. The soldering iron tip temperature setting is needed in the range of 320 to 380 degree Celsius for VIROMET wire. In the normal course of using conventional solder for rework, the soldering iron tip temperature is usually required to be set in the range of 280 to 350 degree Celsius. Again, in huge contrast, the higher tip temperature setting of 370 to 450 degree Celsius is mandatory for those high melting point Lead Free materials.

As regards board sensitivity to heat, land pads for components are somewhat more sensitive to heat damage, requiring less rework temperature and frequency – the ideal matching of VIROMET.

The point here is the number of time and the temperature that a single board is subject to within the production process right up to the final assembly wherein one learns to apply the benefits of judicious material matching. Consider the worse case in a real world production: a board that uses Sn/Cu alloy wave soldering with, say, 255 degree Celsius, then reflowed in a 8 zones reflow oven by using Sn/Ag/Cu paste with peak reflow temperature of 235 degree Celsius, followed by more than one time rework by using Sn/Ag/Cu wire with tip temperature setting at 370 degree Celsius. Copper pad peel off is obvious in this case.

Now do you see why we highly recommend VIROMET to be used strictly without interfacing with other Lead Free material for the benefit of heat sensitive component and board due to higher operating temperature requirement with the use of higher melting point Lead Free materials.

VIROMET WIRES

We take a fair amount of criticism for producing a large number of different wires, mainly for users who have a particular axe to grind. And yes, it's true that we could make more money and have easier life if we just made one wire and one diameter with single type of chemical in the core of the wire. Our reason for offering such wide range of wires is based on our policy of making industrial quality available at all price levels. We take great pleasure in offering premium interconnects production to the discerning but less affluent mass production market segment, as well as catering to those highly automated processes not restricted by budget.

CLF 5013

The CLF5013 has all the features; namely speed, solderability, wettability, for use in general manual soldering. It meets the most stringent requirement for reliability performance in its own raw chemical form as well as being residual remains after soldering on printed circuit board with its formulation exceeds in specifics required and spelt out in ANSI, JIS standards.

It is to be used with soldering iron tips with various cross sectional designs and for tip temperature to be set in between 330 to 380 degree Celsius. Certainly, it was not designed to be used with high setting in tip's temperature above that of 380 degree Celsius, of which, is commonly done by user for high temperature melting Lead Free materials.

We do not recommend CLF5013 in high temperature soldering as it was designed to work in concerted action with our patented low temperature melting point VIROMET Lead Free material, and also for reason, that high wear off rate is usually encountered in tip with higher in temperature setting, thus, leads to increase in operating cost for more tip replacement.

Spattering is not obvious for CLF5013, but, it is definitely not the best with least spatter among the stable of fluxes which we have designed for the use in the core of wire.

Proper ventilation and exhaust system is to be set up in the vicinity of using CLF5013. We strongly disapprove inhaling of fume from CLF5013 as the fume contains chemical particles deemed harmful to human body, although it is strictly non-toxic.

CLF5013 can be produced in wires with different diameters. The smallest diameter of 0.25mm wire without breakage throughout has been successfully introduced and used by users with their highly automated and highly sophisticated feeding mechanism forming interconnects in the final assemblies, the only Lead Free wire in the world that can be used at 280 degree Celsius with tip contact for 4 seconds.

CLF5018

We take pride in developing and making CLF5018 for Sony Corporation for their specific requirement in manual soldering process. CLF5018 shares the same design concept and features with CLF5013, except that the acid value has been modified for the slight change in chemical used in its final formulation. CLF5018 is also catered for general use in the public.

CLF5033

Is this the ultimate formulation of chemicals for use in our VIROMET Lead Free wire we offer to the industry? Yes, we take a fair amount of “stick” for the immodest-seeming question we ask upon CLF5033. But we can explain! By the question asked, we mean in the first instance we have given the best shot at the actual design and formulation for a totally “spatter free” and “non char” execution. This very formulation has been tested and proven in critical applications where price was of no consequence.

The CLF5033’s total “spatter free” and “non char” approach, with fully and tightly regulated solvent and activator system, does enhance wettability, solderability and prolonging the life of the tip in the soldering iron. Please note that the fume from wire with CLF5033 is reduced to bare minimum.

Again, we strongly recommend CLF5033 to be used with soldering iron tip temperature to be set in between 330 to 380 degree Celsius. Experience with prolonged turning on of

soldering iron with flux residue remains on the surface of the tip would eventually lead to charred residual remains and hence, affects both heat transfer and efficiency due to speed slow down in manual soldering. Verily, the charred remains on the surface are hard to remove at times.

CLF5043

CLF5043 has been designed and formulated strictly for the use in smaller wire with diameter not more than 0.5mm. A totally unique formulation for wire only found to be used with highly automated and highly sophisticated feeding mechanism in the manufacturing environment. For reasons of absolute control of flux percentage in the core for very precise disposition of solder mass during soldering process, the texture of CLF5043 is soft and elastic in nature while remains inside the core of the wire and turning hard upon solidification after soldering, thus forming a perfect layer of insulation on the surface of the joint.

CLF5043 is produced with free of breakage throughout the length of the whole wire and it is strictly vacuum packed in the bobbin with “fat” core to prevent oxidation as well as phenomenon of kink occurred on the surface of the wire.

VIROMET PASTES

What? How? Why? are the usual preceding words to questions about this inscrutable paste of ours. First, “what” it means is “Low Temperature”. We refer to **VIROMET** in the sense of importance, for it is the (now) to be discarded conventional Tin Leaded paste that set, and still sets, the standard of the reflow peak temperature of 220 degree Celsius in the SMT reflow process. In simple language, higher peak reflow temperature of more than 230 degree Celsius causes serious damages to the components especially heat sensitive component like QFP. And thereby concerns that melting point of the alloy again, for “high temperature” Lead Free material certainly is, and still, an outstanding issue. For companies who are making industrial grade equipment with warranty more than ten years this is even worst.

For “high temperature” Lead Free materials with melting point

more than 215 degree Celsius, where reflow deemed to include bigger and higher heat capacity oven, longer reflow cycle time, higher preheating zone, longer soaking time to minimize “delta T”, elimination of heat sensitive components, Nitrogen environment and higher cost. Besides all these adjustments and changes, the reflow profile in real world SMT needs for very narrow operating window and for certain applications are notoriously hard to control.

Commonly, in bygone times, we had usually not less than 35 degree Celsius “differential” temperature to play around between the Tin Leaded alloy melting point and the peak reflow setting, but it is no longer the same that we should apply for Lead Free SMT process. To illustrate, for the worst scenario, only 18 degree Celsius “differential” temperature above the melting point of a typical SAC alloy subject to a peak reflow temperature of 235 degree Celsius, which certainly a minimum setting that can be attained for a proper joint to form and to a large extent, still subject to a borderline case of reliability performance should a highly heat sensitive component be involved.

The **347** and **349** versions of **VIROMET** pastes both are supplied with careful blends of chemicals with state-of-art formulations and super high grade powders. The **347** version has four different chemical formulations; namely **5LF**, **H01**, **H02** and **LFA**, which cater for most of the requirements for industrial and electronics grade assemblies currently in the market. The **349** version has only **5LF** and **LFA** formulations to go along with its applications.

The reason of having **347** and **349** versions is basically due to a higher percentage of Indium (7% Wt) used in the **347**. It helps to lower the melting point for **347** and allow the use for a lower limit of even a lower peak reflow temperature of 220 degree Celsius, which is close or similar to that of conventional Tin Leaded alloy. This allows also the process peak temperature setting to meet the minimum requirement of not less than 13 degree Celsius “differential” temperature for a proper joint to be formed by **347** and, under the same circumstance, without causing any damage to any heat sensitive component during reflow in a normal room condition. We have more than one

feedback from the industry that they had used successfully a peak reflow temperature of 213 degree Celsius to reflow **347** and formed good and reliable joints in oven with Nitrogen gas. Surprisingly to note that only 6 degree Celsius “differential” temperature was observed above the melting point of this alloy, which amazingly left with us the imagination what **347** can do in such extreme environment.

You don’t believe this is possible? Our **347** can serve as a direct replacement for conventional Tin Leaded paste in a reflow process. We knew that. You find it very hard to swallow that Lead Free reflow can have as low the peak reflow temperature as in Tin Leaded process. Don’t bet big on it. Hitachi Japan has publicly announced that they had found our **347** as solution to their low temperature and mass production manufacturing for medical products and other industrial graded products which are sensitive to heat damage usually occur in using “high temperature” Lead Free material.

The most arresting impression for using **347** as a replacement of Tin Leaded solder is the ability to set the reflow profile; that is the individual zone temperature setting and the total reflow time within the oven regardless of the number of zones for the oven. Looking at the big picture of the reflow profile setting, the profile will be of resemblance to conventional Tin Leaded profile with cares taken for ensuring peak temperature in the joint during reflow not to fall below 220 degree Celsius in normal atmospheric condition and not below 213 degree Celsius in Nitrogen environment, together with a very slight longer in the preheat and soak time. We do not recommend a very high and very long preheat similar to those settings required by “high temperature” Lead Free material. Neither do we need to have a very long soaking time for **347** before the peak reflow as those happen for “high temperature” Lead Free material as well.

The great portion of the answer to these enigmatic setting of profiles lies in preventing heat damages not just only to the heat sensitive component on board but also to the well balanced and well formulated chemicals which we had put into our **347**. The rest, as we always advise to our user based on the sample profiles that we have designed and plotted out for individual of our **347** formulation.

Having read thus far, we feel sure you'll understand what we mean by the terms esoteric and specialist. Our prayer for the utilization of **347** is that the engineer who chooses it will know that he/she has X number of sensitive components on board which require a peak reflow of not more than 230 degree Celsius and will like the board assembly to be reflowed in the best optimum modes within the oven.

There will be those people who will question the intelligence of making such **347** pastes available at all. Well, the answer is to explain that as a specialist solder manufacturer we want to offer products to the discerning engineers that advance both his/her knowledge and standard toward process innovation in the final electronics assembly business. It saddens us that such conventional Tin Leaded solder together with the then matured process knowledge and innovations accompanying the use of such solder for past decades were actually better than some of today's "breakthroughs" in Lead Free technology.

The design of **347** is such that user should neither be constantly worrying about nor adjusting or changing component and PCB designs in order to accommodate the high peak reflow temperature of more than 235 degree Celsius imposes on the use of "high temperature" Lead Free materials.

The use for **349**, though it shares a fair amount of **347** conceptual approaches but with less percentage of Indium, offers a higher peak reflow temperature of not less than 225 degree Celsius for optimal cost consideration without in the expense of reliability performance in the joint.

5LF

A well established and tried-out formulation which is also the first generation of chemicals used for VIROMET Lead Free material in SMT reflow process. It exhibits a smooth and tacky paste's texture strictly to be used together with metal squeegee. Not the last degree in print definition with continuous print life of not less than 8 hours in print. It has a shorter tackiness time for not more than 10 hours. It is very suitable for mass production with high print volume usage. The only limitation for **5LF** is that bubbles in the residue of the

joint will be observed with use in certain type of boards upon solidification after reflow, and some believe, these bubbles will degrade the reliability performance of the joint, which was subsequently proven otherwise.

Due to the texture of **5LF**, it has also been successfully used for column dispensing and allows the use of super fast preheat ramping with short reflow profile for spot reflow application.

H01

It improves further on print definition and total elimination of bubbles entrapped within the residue with a new formulation used for VIROMET. This new formulation also helps to eliminate voids formed within the structure of the joints usually encountered in the use of “high temperature” Lead Free material. Print life exceeds 8 hours and will have good tackiness up to 14 hours. It is rather sensitive in a low RH% environment.

H02

The best ever Lead Free paste available in the market for the direct replacement to that of conventional Tin Leaded equivalence without sacrificing the entrenched knowledge that one possesses in the industry thus far. You name it, we have it!

Print Definition	-- check!	Excellent.
Print Life on Stencil	-- check!	More than 24 hours.
Tackiness after Print	-- check!	At Least 24 hours.
Texture	-- check!	Creamy and Tacky.

H02 has also been tested and used in environment with very low Relative Humidity. It has been proven to have not less than 8 hours print life in 30%RH atmosphere, one of the most robust pastes that you can count on for your SMT requirement.

VIROMET BAR

Our **349** bar didn't set out to improve on or update the original performance of conventional Tin Leaded 63/37 alloy used in wave soldering process, but rather to have it in Lead Free version again, and to use it in the way it was in all existing wave soldering machines around the world. The pot temperature

remains precisely at 245 degree Celsius, as conventional Tin Leaded 63/37 was designed and used more than half a century ago.

The method of applying fluxes, preheating to the board, Chip and Laminar wave adjustments, similar to that used in Tin Leaded alloy, differs only in the type of flux to be used with **349** in views of the lower surface tension of VIROMET in nature. None of the contraption we need and have seen for machines which are in use together with “high temperature” Lead Free material.

The story behind our **349** was that user could not live happily with any single type of “high temperature” Lead Free material in their wave soldering process, and came to their understanding that there is a better alloy to be used, albeit at a considerable increase in price. This is the best Lead Free material that we have offered to the wave soldering industry. What’s so remarkable about **349** is its ease of use and control during the wave process and also its impeccable “capillary effect” forming perfect joints at the component’s side of Plated-Through-Hole board. Virtually, eliminates the potential hazard of joints “lift off” at the land pad areas.

Although **349** is Lead Free in its composition, it does not behave like to rest of Lead Free materials in Wave Soldering process, indeed, it is very stable in its liquid state under long hours of use. The composition does not vary much during the mass production and, in actual fact, the same **349** is used for replenishment to compensate for drop in solder level within the pot. For those of you who think that Lead Free wave soldering process hasn’t come the same way as what conventional Tin Leaded had shown for almost half a century, the **349** is proof to the contrary. They are the current reference, and are the heart of dip process to allow for high end PCB manufacturing.